

PRODUCTION

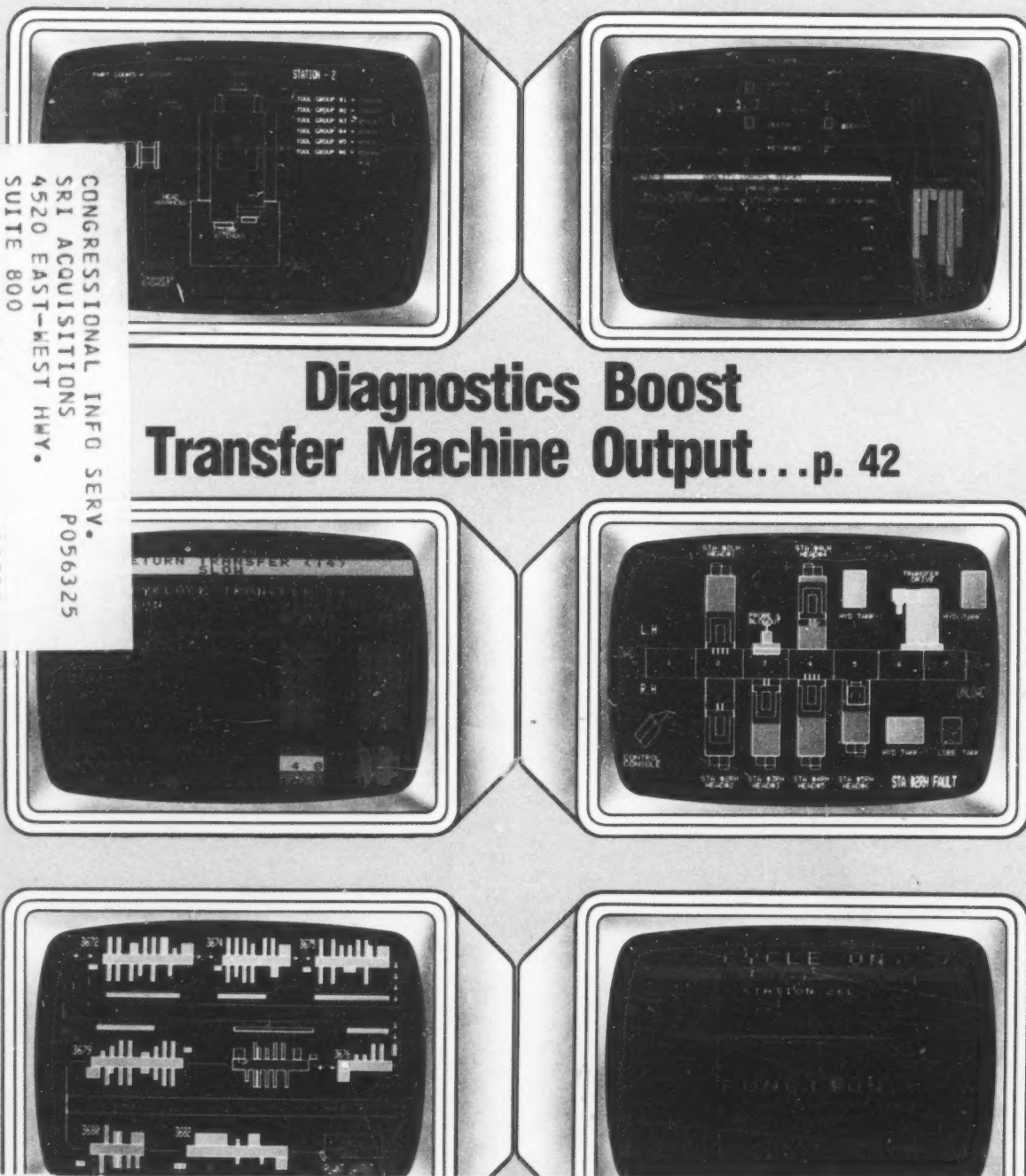
JANUARY 1983

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Diagnostics Boost Transfer Machine Output...p. 42



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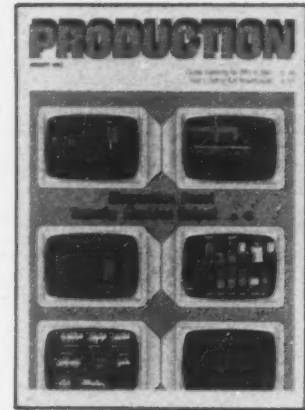
It is the purpose of **PRODUCTION** to recognize and to fulfill the special needs of the managers and engineers who are responsible for improving manufacturing efficiency, costs and quality in production metalworking plants, and selected supplier industries.

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The cover: The illustrations of diagnostic aids were provided by Cross Co., Greenlee Manufacturing Systems, Ingersoll Milling Machine Co., and F. Jos. Lamb

Next month: Round Table participants cope with batch manufacturing

Capital Spending—1983: Up 20%

The hard-line capital spending intentions by manufacturing executives jump upward after a dismal 1982. PRODUCTION's Research Div. surveyed plans for 1983 spending for machinery and equipment in the metalworking industries*. As in past years, findings indicate how funds are intended to be invested and the reasons

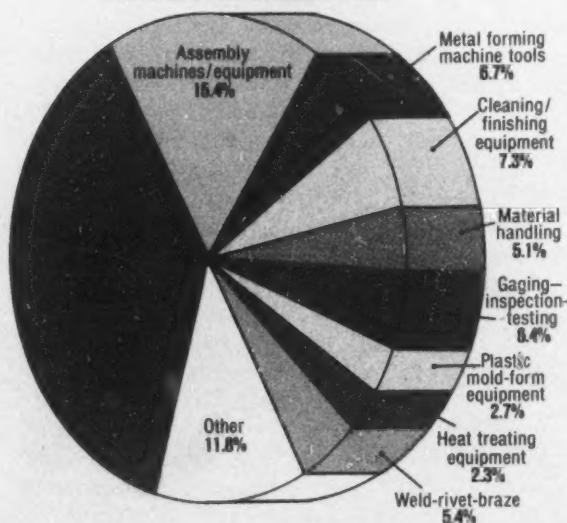
You said, overall, that you planned to ask for \$10.6 billion for 1983 spending. But you also said you expected to obtain approval only for \$8.3 billion worth of equipment purchases—and this is the figure we're using for all projections.

This spending level, while down from your intentions of a year ago, would exceed actual 1982 spending by about 20 percent. And because little or no inflation is taking place in the equipment market, most of this increase is "real."

Using projected capital dollar investments of the \$8.3 billion pie, we are looking at industry equipment buying along these lines: metalcutting machine tools, \$2.984 billion, of which approximately \$900-950 million will be offshore-sourced; metal forming machines, \$633 million, of which approximately \$200 million will be offshore-sourced; assembly machines and equipment, \$1.245 billion; weld-rivet-braze equipment, \$458 million, of which welding equipment makes up 80 percent of the investment; gaging-inspection-testing equipment, \$531 million with inspection equipment accounting for more than half; material handling, \$423 million; plastic molding equipment, \$224 million; and heat processing equipment, \$191 million.

The Overall Spending Profile. You're typical if your plant is planning to apportion its investment for machinery and equipment as depicted by the following table:

**HOW THE 1983
CAPITAL EQUIPMENT
DOLLAR
WILL BE SPENT**
Percent of Investment 1983

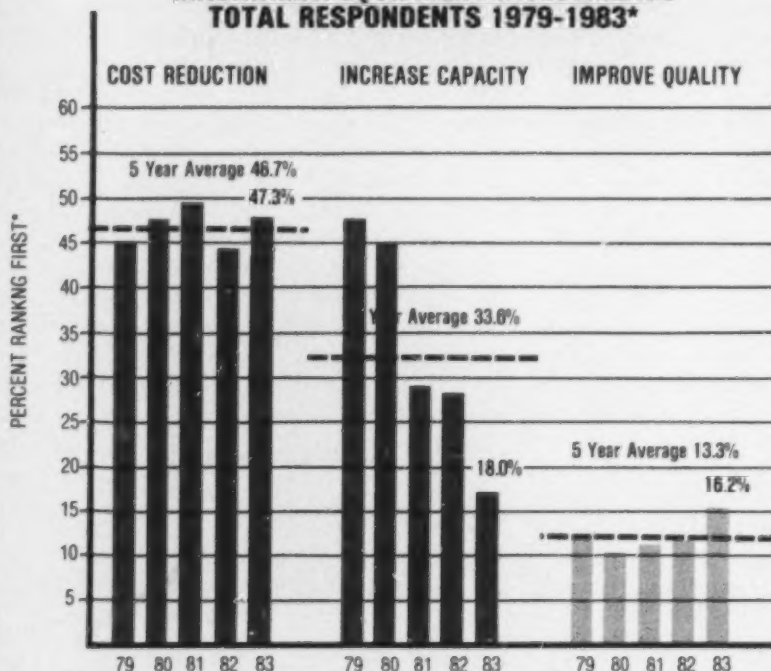


Equipment Type	Percent of Investment 1983
Metalcutting machine tools	36.0%
Assembly machines and equipment	15.4%
Metal Forming machine tools	7.6%
Cleaning-Finishing equipment	7.3%
Gaging-Inspection-Testing	6.4%
Weld-Rivet-Braze	5.4%
Material Handling	5.1%
Plastic Molding and Forming equipment	2.7%
Heat Processing equipment	2.3%
Other	11.8%

Source: PRODUCTION's Capital Spending Forecast 1983

*Survey Scope: Plants reached by PRODUCTION and PRODUCTION's Manufacturing PLANBOOK in: Fabricated Metal Products (SIC 34); Machinery, except Electrical (SIC 35); Electrical Machinery (SIC 36); Transportation Equipment (SIC 37); and Instruments (SIC 38) which employ 50 or more persons. 1983 figures are projected from 2612 respondents from 12,000 plants contacted in keeping with past procedures.

OVERALL MOTIVES FOR PLANNED MACHINERY/EQUIPMENT INVESTMENTS TOTAL RESPONDENTS 1979-1983*

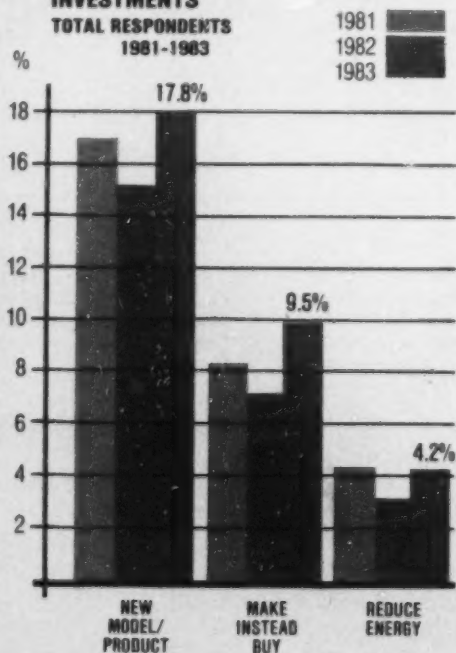


*Adds up to more than 100% in 1979-1983 when some respondents ranked more than one motive first.
Source: PRODUCTION's Capital Spending Forecasts 1979-1983

Cost reduction continues to be the number one motive for machinery and equipment purchases this year. The drop in "increase capacity" was expected based on current utilization. The investment emphasis to improve quality—up almost 4 percentage points this year—was also expected.

OTHER MOTIVES FOR PLANNED MACHINERY/EQUIPMENT INVESTMENTS

TOTAL RESPONDENTS
1981-1983



You're also typical if in 1983 . . .

Your plant employs

50-99 persons
100-499 persons
500-999 persons
1000 or more persons

Your machinery/equipment expenditures are

\$ 138,969
\$ 315,742
\$1,449,181
\$3,442,462

Here are some other highlights:

- You were operating at 70 percent of capacity in the fall of 1982, down from 77 percent a year earlier. At the time of this survey, 52.9 percent of you planned to operate at a higher level of capacity during 1983, while only 8.4 percent thought that they'd be operating at a lower level this year.
- You'll source 80 percent of your total machinery/equipment purchases with domestic

The relative priorities of the "other" motives for capital spending have not changed since last year's report. However, the emphasis in each has increased. New model/new product demands additional equipment to produce. More make instead of buy always shows up in a recessionary economy. And increasing attention to energy reduction through new equipment investment makes good business sense.

suppliers during 1983. That's down from the 84 percent you anticipated spending with them during 1982. Most of this investment will be spent on metalcutting, assembly and metal forming equipment.

- About 73 percent of those responding expected to have their budget requests approved by the end of 1982. And those trying for early 1983 delivery had already placed 9 percent of their 1983 capital funds with suppliers.

- Your company is average if it requires a 33 percent first-year return-on-investment (pre-tax)

in justifying new equipment. That's identical to a year ago and up slightly from the 32 percent required two years ago.

You are planning on more use of advanced technology, as these findings show:

Numerical Control. As in the past, your increasing reliance on and use of numerically controlled equipment stands out in

these surveys. In 1983, 47.3 percent of the total responding plants intend to purchase CNC equipment. That's up 37 percent in plants intending to buy since 1977. Over half, 55.9 percent, of total respondents operate NC or CNC equipment, up from last year's 53.8 percent. These plants account for 86 percent of the purchase activity of CNC machines in plants responding to this survey.

As was true in 1982, horizontal turning and horizontal and vertical machining centers account for the lion's share of intended CNC purchases over the next three years.

Here are the types of machines in the plans, with the year of purchase indicated: (Base: 1236 intending to purchase CNC)

Percent Intending To Purchase CNC, by Type

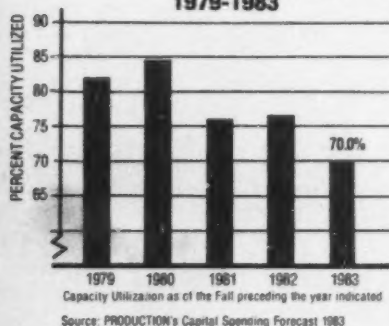
	1983	1984	1985
Machining center, horizontal	22.0%	19.0%	10.3%
Machining center, vertical	19.4%	17.5%	9.7%
Boring	6.3%	5.9%	3.1%
Drilling	10.3%	10.5%	4.6%
Grinding	9.0%	9.7%	5.9%
Milling	11.2%	12.4%	7.6%
Turning, horizontal	31.2%	25.7%	7.6%
Turning, vertical	5.2%	8.2%	4.8%
Punching	6.5%	8.0%	6.1%

Flexible Manufacturing Systems. It's obvious that Flexible Manufacturing Systems mean different things to different people. But one thing is certain. Manufacturers of batches or short lots continue to look for ways to improve manufacturing efficiencies—to figure out how to make money while operating at 65-75 percent of capacity. Almost 15 percent (14.9%) of you say that FMS is in your plans within the next three years. And while these systems range from machining centers and head indexing machines, multiple machining center systems, combination systems to multiple-station automatic systems with limited flexibility, here are your reported plans for purchases, based on returns from all responding plants:

Will Buy Flexible Systems - Type and Timing

	1983	1984	1985
Flexible, single station	4.1%	4.7%	2.9%
Flexible, multiple station	3.8%	3.8%	2.9%

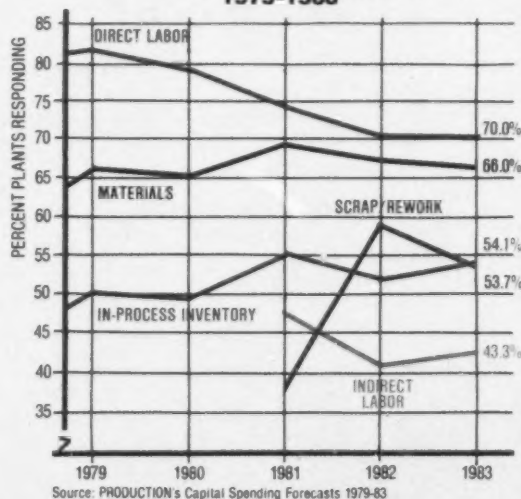
CAPACITY UTILIZATION 1979-1983



A dramatic drop in the level of capacity utilization was reported from last year's survey.

These levels are close to matching the low levels of use reported prior to World War II. Current lack of utilization is reflected in the drop of capacity as a reason to buy capital equipment

MAJOR COST REDUCTION TARGET 1979-1983



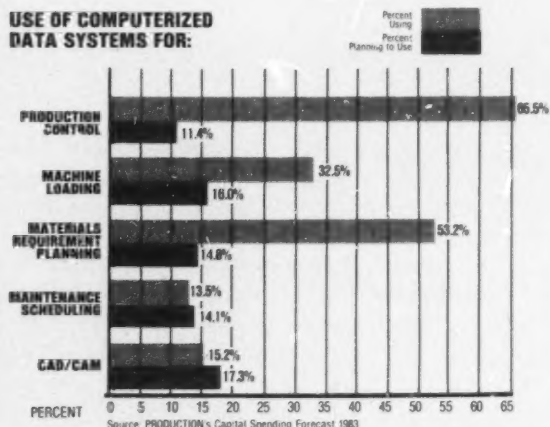
Direct labor continues to be the major target in cost reduction efforts with cost of materials a close second. Coincident with difficult business conditions, in-process inventory and reduction of scrap and rework loom important in respondents' continuing efforts to reduce costs

Computer Use. Use of computers or minicomputers, in addition to stand-alone CNC machines, to control production equipment continues to increase, according to total respondents. Thirteen percent said they now use it to control metalcutting machines; 9.6 percent use it to control gaging operations. Other applications include metal forming (5.1%), welding (4.6%), and painting (2.1%). For the future, 7.1 percent plan to control their welding operations

by computer, 6.6 percent for gaging, 5.5 percent for metalcutting, 3.9 percent for painting and 3.6 percent for metal forming.

Use of computers for other manufacturing assignments continues to grow:

USE OF COMPUTERIZED DATA SYSTEMS FOR:



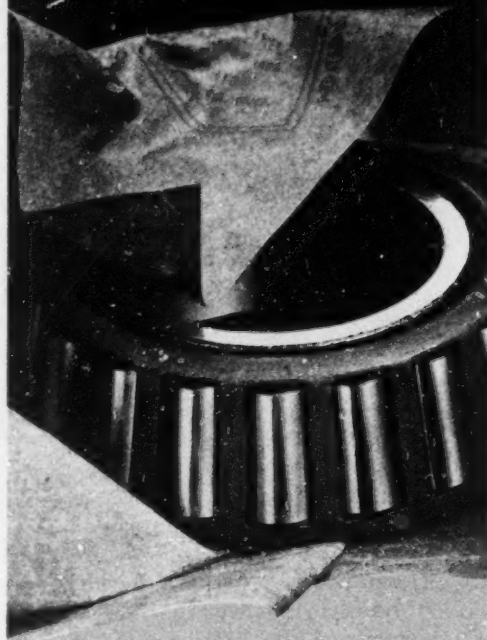
Heavy Robot Considerations. This year's Capital Spending Forecast verifies the manufacturing industries' increased interest in robotics with strong evidence of intentions to buy. Thirty percent of the total respondents report purchase intentions between now and 1985. These intended users of robotics in production operations are in addition to the base of 8.7 percent of responding plants using these devices in production at the time of the survey.

Here's how responding plants report current and planned use of robots in selected production operations:

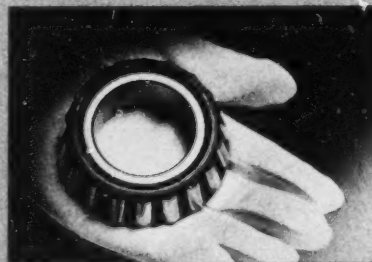
Type of Application	Currently Use	Plan To Use
Machine Load/Unload	7.4%	13.4%
Assembly	3.9%	9.5%
Material Handling	3.0%	8.4%
Arc Welding	3.0%	7.6%
Spray Painting	2.3%	6.1%
Spot Welding	1.1%	3.1%
Other	1.1%	0.9%

Of all plants planning to purchase robots in the next three years, 72 percent will be making their initial purchase. With the experience base slightly over one in four considering purchase, we look for this industry to grow dramatically—most probably at the expense of some other equipment producers over the next ten years. Edward D. McCallum Jr. □

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Today's Need:

Strategic Manufacturing Plans

Some serious inconsistencies in prioritizing manufacturing improvements of known inefficiencies of four groups of manufacturing companies show up in a study made by Arthur Andersen & Co. Uncertainty about future planning is most pronounced among capital equipment producers

Table No. 1
Inefficiencies

as ranked by —

	Auto Suppliers (under \$50M) (over \$50M)		Capital Equip. Manufacturers	Other Manufacturers
Short production runs/excessive setup times	—	—	—	1
Engineering changes/scheduling/methods	—	—	1	—
Employee productivity/restrictive work practices	2	1	2	3
Employee development/involvement/attitudes	1	3	3	6
Inventory charges	2	2	—	4
Shop floor scheduling/control	—	—	3	—
Inventory control/materials	1	4	2	5
Inadequate systems	3	2	—	2
Equipment maintenance/calibration	1	2	1	3
Scrap and rework	4	3	—	7
Inventory charges	1	2	2	7
Lack of coordination/communication	4	3	1	4
Inventory control/materials	1	4	2	5
Marketing strategies and resources	4	5	4	6
Lack of long-range planning	1	2	6	4

America's vaunted manufacturing know-how is looking pretty bedraggled at this point, and observers both within and outside of industry are offering all kinds of reasons for it. A recurring one is the absence of strategic planning in the manufacturing area.

Apparently, most companies have taken a piecemeal approach to their manufacturing improvements, depending on a piece of equipment here and there to get rid of a bothersome inefficiency but rarely analyzing what major steps they will have to take to get to where their business planners think the organizations can go. Goals and objectives are set, but not the necessary actions to achieve them.

A new study by the Detroit office of the accounting/consulting firm of Arthur Andersen & Co. is being offered as a starting point. Its findings were presented recently to an invited group of company executives to help them "focus on areas of required improvement." Coincidentally, the Andersen partner who de-

signed the study, Peter C. Van Hull, was just back from a Japanese trip that served to reinforce the urgency with which he believes American companies must implement broad-scale improvements in their manufacturing systems. The study made no reference to areas where the Japanese appear to be superior, but these were often mentioned in Van Hull's presentation of the study's findings and their implications to American manufacturers.

A key point he made is that whereas the four groups of manufacturers in the U.S. seem to have "only somewhat defined" their "how-to" strategies for achieving objectives, the Japanese "have done a very good job of defining the 'how-to.'"

The study was a follow-up to and expansion on a 1981 Delphi survey by Andersen of automotive industry suppliers, including capital equipment producers. In that survey, emphasis was on the condition of and future outlook for those industries (see "Danger! Rough Road Ahead," PRODUCTION, May 1981, p. 88).

The new study attempts to pinpoint more precisely problem areas in manufacturing of four groups of goods-producing companies—small (under \$50 million of sales) and large (over \$50M) suppliers of automotive parts, capital equipment producers (for the most part builders of standard and special machine tools), and other manufacturing companies in a variety of industries. Respondents generally had vp/general manager or higher titles; there were 37 responses from the small automotive suppliers, 60 from the large suppliers, 20 from the capital goods producers, and 32 from the other manufacturers.

The capital equipment producers consistently diverged from the other three groups in the perceived nature of their

Table No. 2				
Capital Equipment/Production Process Changes for Improving Competitiveness				
as ranked by —				
	Auto Suppliers (under \$50M)	Auto Suppliers (over \$50M)	Capital Equip. Manufacturers	Other Manufacturers
Reduced setup times	1	2	4	3
Improved production and inventory control systems	3	1	1	2
Improved tooling quality and maintenance	2	3	7	2
Reduced machine downtime for repairs	3	2	7	5
New equipment	2	5	5	1
Reduced material shortages and defective material	5	4	2	6
Plant layout changes and improved material flow	4	2	2	4
Improved labor relations	6	5	4	7
Use of standard container and lot sizes	7	6	4	8
CAD/CAM systems	8	7	3	9

problems and in the kinds of actions they think they need to take to solve those problems. They also expressed more uncertainty about their future and the ways they can improve their competitiveness. Two explanations for the divergence and for the greater degree of uncertainty of this group were offered: The nature of the capital equipment producers' business is fundamentally different from that of the other three groups; and, with respect to slumping demand, "they fell out of bed later than the rest," Van Hull noted.

In answer to a question about stability in market demand and production schedules for 1982-1985, only 24 percent of the capital equipment builders see more stability, contrasted with majorities looking for more stability in the other three manufacturing groups (60%, large suppliers; 59%, small suppliers; 55%, other manufacturers).

Lack of Match for Problems/Actions. In presenting the data from the study about the perceived internal problem areas and the priorities for corrective actions that seemingly have been assigned (see Tables Nos. 1, 2 and 3), Van Hull noted many inconsistencies and contradictions. Often the actions being planned do not seem to match very closely the indicated problems.

For example, both groups of auto supplier companies put "reduced setup time" at the top of their lists of changes they plan to make for improving competitiveness through equipment and process changes. Yet they do not specifically note this as a major current inefficiency problem. Similarly, these two groups put employee productivity/restrictive work practices/attitudes at the top of their listing of current causes of inefficiencies; yet improved management of human resources

The remedial actions being planned do not seem to match the indicated problems

or improved labor relations are given only moderate priority in their lists of needed changes in operating conditions for improved competitiveness.

An inconsistency of answers between groups was introduced, too, by changes in wording of the problems for different groups after the first round of Delphi questioning, based on comments to open-ended inquiries.

The inconsistencies that show in various parts of the study give rise to the Andersen contention that not enough strategic manufacturing planning is being done. In audience discussion, the point was made repeatedly that the

Van Hull amplified the terminology by explaining this means "systems, methods and procedures." He said the study indicates an awareness of the need "to manage things better, not throw money at machines." Only the "other manufacturers" rank new equipment either on a par with or above the need for systems improvements to gain competitiveness.

Lowest in ranking of the manufacturing process/equipment changes needed for all groups except the capital equipment builders are CAD/CAM systems, and Van Hull commented that "as we read the magazines, we see a lot of solutions looking for problems to

all groups except the capital equipment builders for providing the lowest cost production methods as opposed to ability to cut setup times. Volume rather than flexibility is perceived as the primary route to lower cost. And volume is the ingredient mainly lacking now for the respondent companies.

Van Hull noted that despite the desire for better methods of scheduling and inventory control, the Japanese "just-in-time" Kanban system "is not going to happen very quickly in the U.S." It is of greater interest within the automakers than among their suppliers or other manufacturers, he said.

Table No. 3
**Changes in Operating Conditions for
Improving Competitive Position**
as ranked by —

	Auto Suppliers		Capital Equip.	Other
	(under \$50M)	(over \$50M)	Manufacturers	Manufacturers
New systems techniques	1	1	1	3
New machine tools	2	3	4	1
Improved management of human resources	3	3	2	2
Improved labor relations	4	2	5	4
Improved investment climate	4	4	3	3
Government/industry cooperation	5	5	7	5
New physical plant	5	6	6	4

views from the front office—the survey respondents—and from the shop floor are often miles apart.

The primary initial need in many companies, Van Hull suggested, is to find out "what the problems are, plant by plant. Then look at possible solutions." He recommended an internal Delphi survey as the starting point.

Strong Emphasis on "Systems." The most clearly called-out need in the four manufacturing groups is for "new systems techniques."

solve."

The areas of major concentration by all four groups appear to be those associated with scheduling, flexibility, and inventory control; and setup time reduction is ranked as the first priority by two of the four groups. Yet, strangely, in a question on how much setup time reduction the manufacturers can obtain in the 1982-85 and 1986-90 periods, the answers were for only an average 10 percent reduction in each of these periods. Long production runs are credited by overwhelming majorities in

Competitors' Advantages?

The study says respondents seem not to fully grasp the nature of the competition they're facing or the source of their own weaknesses or competitors' strengths. It comments: "Companies only sometimes effectively research competitors' products and manufacturing methods to identify competitive advantages and disadvantages."

Each of the groups was asked to compare its products to those of the competition on five points: "easily manufactured," "high quality," "durable/reliable," "competitively priced," and "delivered on time."

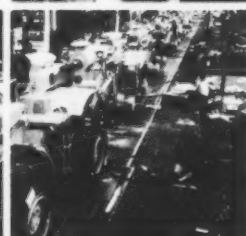
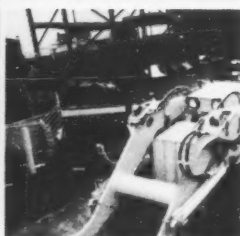
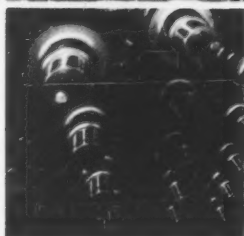
All four groups believe their products are better than competition's in quality and durability/reliability. However, they all believe (in varying degrees) that their products are not as easily manufactured as their competitors'. They think price is about a stand-off, with a slight edge going to competitors. And most of them think their on-time delivery is better. H.C.T. □

EDITOR'S NOTE: For a copy of the Arthur Andersen & Co. study entitled "Manufacturing Strategic Planning Focus," write on your letterhead to Editor, PRODUCTION, P.O. Box 101, Bloomfield Hills, MI 48013.

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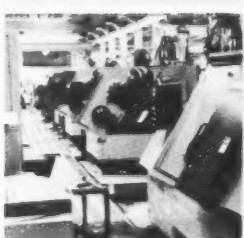
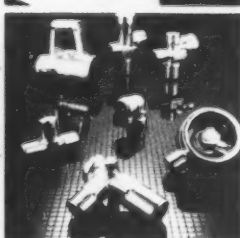
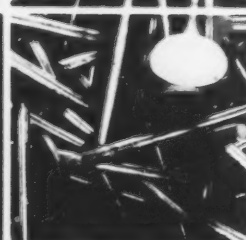
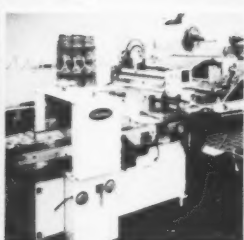


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A PRODUCTION Round Table

BATCH MANUFACTURING: On the Brink of Breakthrough ... p. 40



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PRODUCTION

It is the purpose of **PRODUCTION** to recognize and to fulfill the special needs of the managers and engineers who are responsible for improving manufacturing efficiency, costs and quality in production metalworking plants, and selected supplier industries.

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Round Table—Batch Manufacturing: On the Brink of Breakthrough

Bad News: Product lifetimes, cash reserves and skilled labor pool are all shrinking. Good News: Recession is forcing more enlightened attitudes on the part of top management toward manufacturing; traditional approaches to capital equipment justification are giving way to a longer-range view

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Precision without Prints

Computer routine makes it possible for companies in the tool and die industry to utilize the capability of NC to accurately describe shapes or undimensioned point locations without requiring detailed part drawings

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Escaping the 'Job Shop' Trap

Donald Ewaldz, Ingersoll Engineers, offers some rules for escaping the trap: Understand your products' cost/volume profile; don't get trapped by tradition; don't spend time on nuisances; know the real cost of exceptions

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Integrating the Manufacturing System, Coordinating Productivity Improvements

How does the job title of "computer-integrated manufacturing systems engineer" grab you? It's being seriously considered as a new I.E. function

55

Burning away Burrs

The thermal shock generated by igniting methane in a pressurized chamber is being used in place of tedious manual methods to "burn off" thin, wafer-like burrs on valve bodies

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Wrap-Up

- New Use for CNC
- Steaming New Life into Cutting Tools
- Grinding Wheels Dressed Once-a-Month
- Productivity Crunch Eliminated



The cover: Batch manufacturing Round Table participants are grouped with examples of their companies' products. Clockwise: Eaton truck axle assemblies, Terex earthmoving equipment, TRW automotive valves, Warner & Swasey turning machines, Hill Acme forged brass parts and Nordson packaging equipment

Next month: Production of net shape parts is becoming a reality

Emerging new roles for the I.E.

Integrating the Manufacturing System, Coordinating Productivity Improvements

How does the job title of "computer-integrated manufacturing systems engineer" grab you? As far as we know, no one has such a title. But it is being seriously considered in an engineering school as a new graduate-degree discipline.

It would be the Industrial Engineering equivalent of an MBA. And it would formally further develop and provide recognition for the unique combination of engineering/management skills that I.E.s have traditionally mastered.

Dr. Curtis J. Tompkins, Dean of the College of Engineering of West Virginia University and chairman of the Industrial Engineering Div. of the American Society for Engineering Education, believes there is a need in the universities to create this "new breed" who will fill a gap that industry increasingly is recognizing.

"It's my view that we are moving toward something that is a heresy until you think about it a little bit. I predict that in the next five to ten years what you are going to see is a very technical generalist called 'the computer-integrated manufacturing systems engineer,' or something equivalent to that. It will grow out of the Industrial Engineering program.

"It will take the perspective of the total system, from the order coming in the front door to the product going out the back door; and it will integrate

all of the necessary activities on a comprehensive basis," Dr. Tompkins observes.

The "Forgotten Man"? His comments are only one indication that the industrial engineering profession is gearing itself for a much stronger leadership role in industry, and outside of industry.

As the engineering discipline that introduced a myriad of skills and concepts to the industrial environment—ranging from cost accounting, through work measurement, return-on-investment analysis techniques, human factors considerations, operations research, and much more—the image of the scope of industrial engineering somehow became narrower than when it started. I.E.s in many organizations are given smaller and more specialized roles than would be of maximum value to the overall system in which they function. One consultant believes that they're looked at principally as "measurement scientists," and he contends that too few have capitalized on and promoted their capabilities as "integrators," which should, on the basis of the breadth of their cross-discipline training and knowledge, be one of their major strengths.

While not entirely "the forgotten man," they seem quite often to exemplify the Biblical characterization that "a pro-

phet is not without honor, save in his own country."

Dr. Frank K. Wolf, head of the Industrial Engineering Dept. at Western Michigan University, says the prevailing notion that the I.E. is interested mainly or solely in "methods" is not accurate and is damaging to the profession's true breadth. At the undergraduate level, Dr. Wolf says, many of the new courses emphasize training in "engineering design."

These are open-ended courses in which the student (or team of students) is presented with a manufactured product, told its annual volume requirements and some constraints about the facility in which it will be produced, then is given the semester in which to develop the total, detailed plan for its manufacture.

As the universities well know from the overtures of recruiters and the consulting engagements of their I.E. professors, the industrial engineer is being abundantly recognized for his or her skills outside of manufacturing companies.

Today's problems in industry, which often are overall "systems" problems, may very well be the lever that will pull I.E.s into positions with more comprehensive responsibility in their organization.

Ray Levulis, vice president of the Chicago-based consulting firm of Case & Co., says that

**The I.E.
may be
"the prophet
without
honor is
his own
country"**

the I.E. has only recently started to be recognized and accepted as the generalist that he or she really is. With adeptness in many directions, too often the I.E.'s work has been "focused too narrowly," he contends. The ideal corporate location from which the I.E.s can provide the coordinated approach that often is lacking for full application of the systems concept is through "some kind of manufacturing services organization" with I.E.s acting as internal consultants, he suggests.

Many of industry's problems, almost regardless of specific symptoms, can be lumped under the heading of "lagging productivity growth"—not enough output in relation to the inputs.

Rediscovering the Productivity Improvers. Industrial engineering, as the discipline

that is expert in measuring inputs, also is the presumed expert in plant layout, material handling and flow, and resource management, including human resources. On the basis of these facts alone, it would seem logical that industrial engineering would be the discipline to which a company's executives would turn when an improvement in the organization's productivity is seen as the major current requirement.

Strangely, however, that's not where most companies are looking for leadership and coordination of productivity improvement.

Says Industrial Engineer Ken Harmon of the Productivity Div., Maritz Motivation Co., Cincinnati: "It's quite interesting to look at the 250 or 260 major companies that have what you could call a specific company-wide productivity-

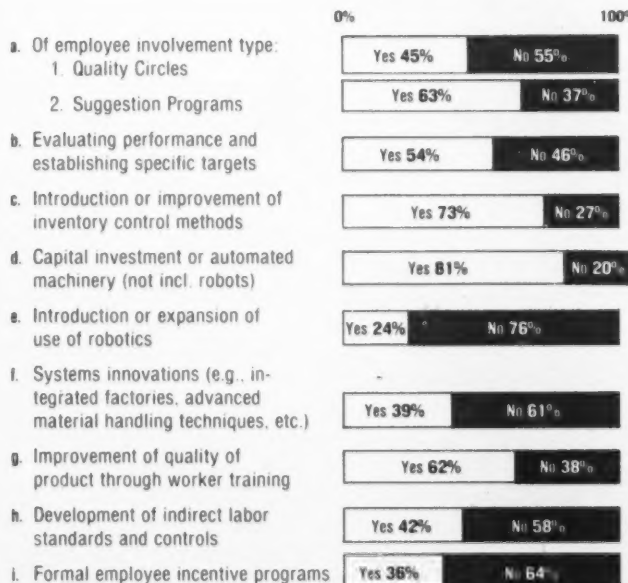
improvement program. In less than 5 percent of this total is the company's productivity program also the responsibility of an I.E. manager." The reason, he believes, is that many i.e. professionals are totally occupied with their day-to-day manufacturing support activities and have not been encouraged by their superiors to think in broad enough terms about the overall productivity issue or how their skills as integrators could be utilized at the CEO/COO levels of the organization.

"The I.E.," he complains, "is not being fairly recognized at the top of the organization for his (past) work in improving productivity."

For the past two years, the Institute of Industrial Engineers (formerly the American Institute of Industrial Engineers) has been stepping up its activities to raise public

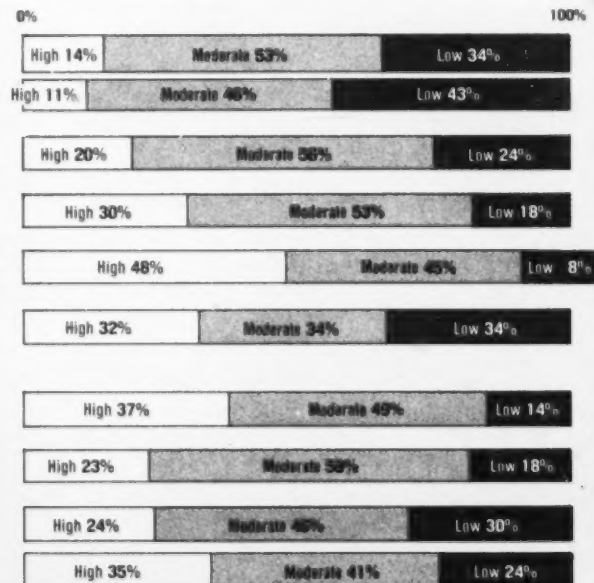
"The I.E. is not being recognized for his past productivity-improving work"

Productivity Improvement Programs Undertaken in Past Five Years



Source: Institute of Industrial Engineers

Effectiveness of the Program Where Undertaken



**I.E.s should
focus on
"conceptual"
work-design
of the optimal
system**

awareness of the I.E.s' capabilities as "productivity engineers" and to help focus the I.E.s' own sights more squarely on the ways they can optimize the total productive work system.

One mission of the president of IIE, Barry M. Mundt, a principal in the Atlanta office of Peat, Marwick, Mitchell & Co., is to explain how and why the I.E.'s role is changing, and broadening. The Institute's board of trustees in 1980 and 1981 identified the major evolving societal issues that would impact I.E.s and looked also at the ways in which I.E.s' work could be more effective in this changing environment.

Traditionally, the I.E. has concentrated on the micro-analysis of the manufacturing workplace. The greater need now, Mundt stresses, is for I.E.s to focus on "conceptual" work—design of the optimal system—while turning over to I.E. technicians the portions of the I.E. functions that do not require a graduate engineer. Mundt also emphasizes that industrial engineering is not only "the management-oriented engineering discipline" but "it also is a human-oriented discipline. Everything an I.E. does involves the integration of people, material, equipment and energy."

The people aspects of productivity improvement will get heavy attention in the speakers program. Maritz's Harmon now is assembling for the 1983 annual Industrial Engineering Conference and Show in Louisville, May 22-26.

Harmon is a member of the Institute's Special Productivity Projects Committee, set up several years ago to help focus the Institute's support of mem-

ber I.E.s more on the leading edge aspects of productivity improvement strategies and technologies. The emphasis in this particular program, Harmon explains, is on "the 'management' approach to productivity improvement as apart from the 'automation' or 'systems engineering' approach."

"The I.E.s know through their work simplification experience that the person on the (production) line has a lot of good ideas. In the past, however, work design was often reserved for the I.E. who then 'involved' line employees only when it came time for implementation," Harmon explains. Now, he notes, with greater emphasis on participative management, including such processes as Quality Circles and other employee involvement methods, the practice is to encourage employees in small groups to apply operational analysis and to design methods improvements and better workplace layouts themselves. The I.E. is an ideal facilitator and technical resource for such activities, Harmon and Mundt believe.

While some I.E.s seem threatened by this "encroachment" on their traditional bailiwick, Harmon points out that the Quality Circle concept, more than any other single development, "showed us how important it is to have a facilitator who helps manage the improvement process, independent of day-to-day operations."

"With this development, American managers are beginning to more fully comprehend the true potential of the I.E.'s internal consulting and facilitating role," he says.

Many of the Institute of Industrial Engineers' efforts, including the contents of the

Louisville program, aim at strengthening the I.E.s' competence for this expanded role.

High Pay-Off Improvements.

The Institute has sampled its membership to get a fix on the types of productivity-improvement programs being carried

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on within the organizations for which these members work, and to get an indication of the apparent effectiveness of the particular approaches. The results of this survey are summarized in the foregoing chart.

The four most prevalent recent productivity-improvement efforts are, respectively, capital investments in equipment and automation (not including robots), introduction or improvement in inventory control methods, use of suggestion programs, and improvement of product quality through more worker training.

Ranking at the top in effectiveness as productivity improvers are the capital equipment investments and systems innovations (integrated factories, advanced material handling techniques, etc.).

A comprehensive 16-p. analysis of this survey, including details provided by the sampled I.E.s on the specific actions that have been taken within their identified productivity-improvement programs, is available at \$1 a copy from the Institute of Industrial Engineers, 25 Technology Park/Atlanta, Norcross, GA 30092. Howard C. Tuttle. □

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Manufacturing PLANBOOK 1983-84

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Westec '83 Show Highlights

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The cover: The pigskin look of **PRODUCTION'S** Manufacturing **PLANBOOK** may earn this frequently consulted tool a place on your desk

Next month: Integrated manufacturing cells—what they'll do for you

Manufacturing PLANBOOK 1983-84

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126 **Westec '83**

The West's largest trade exposition shows off the manufacturing technology of the '80s. Although slightly smaller than last year's show, it brought together equipment from 540 exhibitors from some 20 countries

banking or nonbanking financial institutions.

New Trade Adjustment Center Established

The Institute of Science and Technology of the University of Michigan (Ann Arbor, MI) will establish a Great Lakes Trade Adjustment Assistance Center (TAAC) with a \$750,000 grant from the U.S. Dept. of Commerce.

The types of assistance provided by TAACs to manufacturers that have been adversely impacted by foreign competition were described in PRODUCTION's "View-

point" in April 1982 (p. 21), which also listed the 11 Centers then operating.

The new Great Lakes TAAC will serve manufacturers in Michigan, Ohio and Indiana. Its director is Marian J. Krzyzowski and its program administrator is Larry Crockett.

Foreign Investments In U.S. Continue To Slide

Although 85 investments were made by foreign companies in the machinery industry in the U.S. in 1982, the total number of manufacturing investments in the U.S. by foreign organizations continued

the slide that began in 1980.

The Conference Board's study showed a peak of 434 foreign manufacturing investments in 1979, dropping to 388 in 1980, 348 in 1981 and 271 in 1982. The drop was particularly pronounced in new plant constructions, totalling only 63 in 1982 compared to 182 in 1979. Expansions of existing facilities totalled 53 and acquisitions of U.S. firms was 155.

New York State led in the location of the foreign companies' investments, and British organizations, followed by Japanese, German, Canadian and French companies, were major investors. □

ROBOTICS/AUTOMATION

What Robots Mean To Job Creation/Loss

It's fashionable in discussions about robots to make categorical statements about (1) their creation of many new jobs or (2) their elimination of hordes of workers. Until now, such statements had little basis except opinion.

Two studies by the W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, are providing a more-definitive and balanced look at the question of "more" or "less." The first of these studies was entitled "Robotics—Human Resource Implications for Michigan"; the second, entitled "Human Resource Implications of Robotics," extends the findings to the U.S.

The meat of the studies is that the near-term (to 1990) impact of robotics with respect to employment is not substantial, either in terms of jobs created or jobs eliminated. There have been exaggerated notions in both directions.

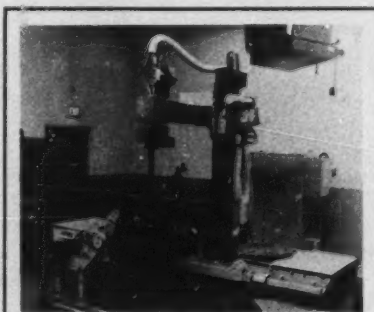
Not surprising, however, is the

studies' contention that many new jobs being created by robotics are of high-skill content, while those eliminated are of the semi-skilled and unskilled variety. And in Michigan, at least, the two occupations most heavily impacted will be welders and spray painters. The largest job gain will be of "robotics technicians"—a new occupation that the Upjohn studies define as

"an individual with the training or experience to test, program, install, troubleshoot, or maintain industrial robots." The employment in robotics of graduate electrical, mechanical and industrial engineers is expected to be the second biggest gainer.

No 'Revolution.' The studies are useful also in their attempts to bring down to earth some unrealistic but widely held expectations about robotics. Robotics (read "high technology") has been heralded as the source of economic salvation for the State of Michigan. The subject also has been touted as the ultimate answer to overall industry's need for higher productivity. Considerable guts were displayed by Authors H. Allan Hunt and Timothy L. Hunt in writing the following in their introduction to the Michigan study:

"First, we submit that the very use of the word 'revolution' (as in 'the robotics revolution') is inappropriate when dealing with any manufacturing process technol-



To be demonstrated by Advanced Robotics Corp., Hebron, OH, at this month's American Welding Society show in Philadelphia will be five Cyro robotic welding cells, each consisting of a robot, robotic positioner and suitable fixturing.

ogy. Capital goods for production have long lives and are not scrapped immediately when something better comes along. Numerically controlled machine tools, usually regarded as the most closely related capital equipment to robots, expanded at a growth rate of only 12 percent for the most recent ten-year period. After 25 years, only 3 to 4 percent of all metalcutting machine tools are numerically controlled. Even digital computers, widely heralded as the most significant technological innovation of the 1960s and 1970s, expanded at a growth rate of only 25 percent, yet many are implicitly assuming much higher growth rates for industrial robots. In terms of actual application, all process technology changes are evolutionary rather than revolutionary because there are physical, financial and human constraints on the rate of change of process technology."

Later in their Michigan report, the Hunts say, however, that "we expect strong growth in the utilization of industrial robots in the decade of the 1980s. By 1990 the total robot population in the U.S. will range from a minimum of

50,000 to a maximum of 100,000 units. Given our estimate of the yearend 1982 population of approximately 6800 units, that implies an average annual growth rate of between 30 and 40 percent for the eight years of the forecast period, or roughly a seven- to 14-fold increase in the total population of robots."

There's another nugget from the Michigan report's introduction that should be recalled when people are talking about the pros-

pects for "disappearance" of the automotive industry, or massive capital equipment investments or universal acceptance of robots in and out of the metalworking industries:

"We do not expect the total collapse of the automobile industry, a major renaissance in U.S. capital investment, the early development of nonmanufacturing robot applications, or the widespread adoption of robotics technology by small firms," the Hunts say. □

**Displacement Impact of Robots in Michigan
by Application, Cumulative 1978 to 1990**

Application	Autos		All other manufacturing		Total	
	1978 employment level	Displacement range (percent)	1978 employment level	Displacement range (percent)	1978 employment level	Displacement range (percent)
Welding	14,910	15.2 - 19.5	22,694	2.0 - 3.6	37,604	7.2 - 9.9
Assembly	65,764	4.5 - 9.5	50,678	0.8 - 2.4	116,442	2.9 - 6.4
Painting	4,378	29.2 - 40.6	4,387	6.0 - 10.3	8,765	17.6 - 25.4
Machine loading/unloading	42,149	8.4 - 13.5	86,906	1.7 - 3.2	129,055	3.9 - 6.6
All operatives and laborers	206,927	5.1 - 8.6	397,598	0.7 - 1.5	604,525	2.2 - 4.0
All employment	409,506	2.6 - 4.3	769,841	0.4 - 0.8	1,179,347	1.1 - 2.0

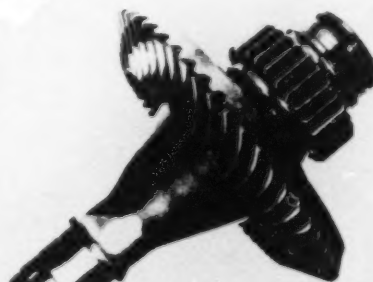
Source: W.E. Upjohn Institute for Employment Research

TECHNOLOGY UPDATES

Double Vacuum-Melted Steels Improve Gears

Three grades of specialty steels have improved the performance of gears used in the drive systems of the U.S. Army's Chinook helicopters. The helicopters, manufactured by Boeing Vertol Co., Philadelphia, PA, use three grades of specialty steels manufactured by Carpenter Technology Corp.'s Steel Div., Reading, PA.

Boeing Vertol's engineers report



The double-vacuum process used to produce the steel for this helicopter transmission gear is said to provide cleaner, sounder alloys

the new CH-47D helicopter has increased safety and survivability advantages, lower life-cycle costs and reduced weight and operating noise thanks to the use of Types AISI 4340, 9310 and BMS 7-223 specialty steels in rotor transmission components instead of conventional, single vacuum-melted AISI 9310 steel.

All three materials now used in the transmissions are produced first through vacuum induction

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A Declaration of Interdependence

In the United States of America, 1983.

When in the course of national events, it becomes necessary for our people to arrive at a Unified Industrial Economic Policy, we offer to our Government, our Industries, and our People, whatever their Ranks or Stations, this Aggregation of Opinions and Proposals, which aim at providing the Framework and the Concepts necessary for a Revitalization and a Strengthening of American Industry. We pray that through greater Concern and Cooperation from all Segments of our Society, a Consensus for this necessary end will be achieved.

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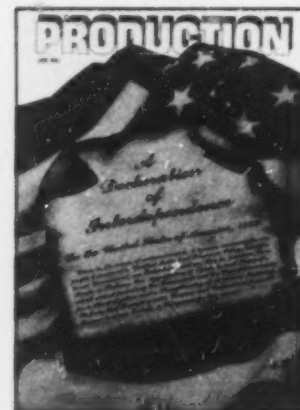
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The cover: The style of the historic 1776 Declaration of Independence is followed in our interdependence statement

Next month: Organizing, selecting a Flexible Manufacturing System

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A Declaration of Interdependence

To strengthen and revitalize American industry, **PRODUCTION** believes a Unified Industrial Economic Policy is needed. Opinions and proposals from a cross-section of thought-leaders provide the framework for such a Policy, covering five important aspects:

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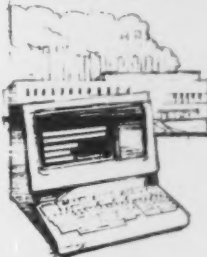
ARTICLE I: Proclaiming What America Stands For



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ARTICLE II: High Tech & Smokestack Interdependence



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ARTICLE IV: Productivity & Living Standard Interdependence



Statements from:
Dr. Keith E. McKee
and Jack D. Sparks

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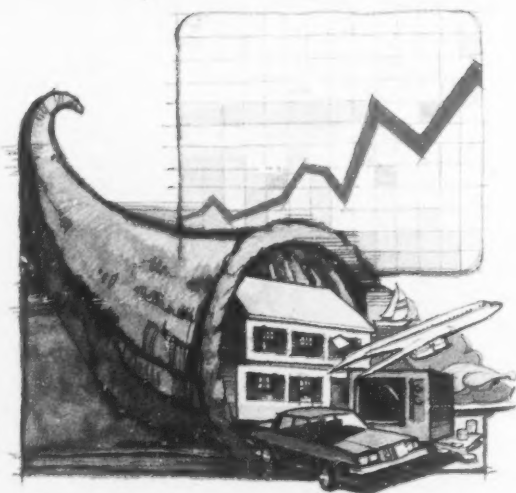
ARTICLE V: Labor & Management Interdependence



Statements from:
Philip Caldwell,
Raymond J.
Donovan, and
Roger B. Smith

ARTICLE IV:

Productivity & Living Standard Interdependence



"Today's core problems can be phrased relatively simply for many U.S. manufacturers. Wage rates and local environmental standards in developing coun-

tries are significantly lower than those in the U.S. Product and production technologies can often move across national borders easily and have been doing so more rapidly in a variety of countries by semi- or fully automated techniques, and capital is relatively easily available to qualified users in most locations throughout the world." This statement by Prof. James B. Quinn, Dartmouth College, in his keynote address late last year to the National Academy of Engineering summarizes the situation confronting most U.S. manufacturers. If they are to be competitive in either domestic or overseas markets, they must improve their productivity. In most particulars, if this is to happen, our government must help, rather than hinder, the effort.

Whirlpool Corp.'s chairman, Jack D. Sparks, and Dr. Keith E. McKee of the Manufacturing Productivity Center note in their accompanying statements instances where misguided or conflicting governmental activities/policies are handicapping U.S. manufacturers.

For some years, this has been a common complaint

(continued on p. 103)

'We Should Be Striving For Technology Solutions'

Dr. Keith E. McKee
Director, Manufacturing Productivity Center
IIT Research Institute

The role of technology is critical in the economic competition in which the United States is engaged. For a variety of reasons there seems to be widespread feeling that U.S. technology has failed. We should be striving to improve the extent to which technology provides solutions to national problems and provides the United States with competitive economic advantages.

The U.S. competitive position can be compared based on productivity. Productivity is a measure of the efficiency with which capital, energy, technology, management and manpower are used. In a free market situation, the cost would be a direct measure of the productivity

—the lower the cost and price, the better the productivity. There is a relatively free market in the United States, and the more productive company within an industry prospers over its less productive rivals. The international money market, exchange rates, tariffs and export incentives all cloud international price comparisons on a microscopic scale. On a macroscopic scale, the balance of payments represents a good indication of relative productivity among nations. The United States had a trade deficit in excess of \$30 billion in 1981.

The table on p. 102 is a comparison of labor productivity for various manufacturing industries in the United States and Japan.

It will be noted that the U.S. has a significant advantage for food, apparel and footwear, pulp and paper products,

leather products, and fabricated metal products. Japan has a significant advantage for iron and steel, chemical industry, electrical machinery, automobiles and instruments. It is interesting to note that the U.S. advantage is for products that rarely enter the international trade market while Japan has the advantage in exported products.

Japan is not the only nation that has caught up with the United States in overall manufacturing productivity since the 1980 data. France also has caught up and Germany is not far behind and closing the gap.

The following questions are a few of the many that might be considered to see how we can use technology better:

Why are we doing it? A significant portion of development and design work never bears fruit. We must understand that such technical effort expended is lost forever—no matter how effectively the technologists did their job the resulting productivity was zero and perhaps even worse be-

cause other needed technical work is not done.

Why don't they make up their minds? The technologists normally ask this question relative to non-technologists. The technologists themselves are equally guilty. It is not uncommon to find tooling costs doubled or even tripled due to engineering changes, and increases in cost of 20 percent to 60 percent due to changes are not uncommon. Again the effort and cost introduced is lost for other uses.

Are technologists more interested in technology than in solving problems? One often gets that impression. Major projects are undertaken to improve technology when there is no unanswered problem requiring this improved understanding. Projects done that have no potential payout must be considered a total waste with zero productivity.

Do we know where we are going? The technical resources of this nation are pushed and pulled in various directions by national needs. Aerospace technology was the No. 1 need of the early 1960s and the brightest of the technologists were drawn into this field. Then shifts in the national objectives resulted in many of these people being excess. More recently we have seen the same flip-flop on energy. We are now being told that there is a shortage of engineering educators and yet many of last generation's would-be educators were driven out of the education system because

COMPARATIVE JAPANESE PRODUCTIVITY BY INDUSTRY

U.S. = 100

> 100 Japan is more productive than U.S.

< 100 Japan is less productive than U.S.

	1980 (est.)
All Industry	96
Food	58
Textile	98
Apparel and Footwear	52
Lumber and Wood Products	97
Pulp and Paper Products	64
Chemical Industry	118
Rubber Products	97
Leather and Products	67
Stone, Clay and Glass	86
Iron and Steel	201
Nonferrous Metal	93
Fabricated Metal Products	73
Machinery except Electric	104
Electrical Machinery	126
Automobiles	134
Instruments	114

they were not granted tenure. Such changes in national direction have treated technology as an unlimited resource that could be used without concern for the future.

Must we do it ourselves? We strongly support the U.S. competitive

system, but there are many examples of technology development which do not appear to impact competitiveness being done simultaneously by several companies. We would ask if pollution reduction for cars could not have been done by the auto industry as an industry rather than by each company. In most instances involving environment and safety, systems and processes could be done cooperatively without loss of competitiveness and with a considerable saving of the technological resources. For example, if U.S. industry pursues flexible machining systems and flexible manufacturing systems using the traditional laissez-faire approach, U.S. manufacturing will fall behind the international competition and the few U.S. companies that remain competitive will do it at great cost vis a vis the overseas competition. It is not productive for the nation to have everyone do it themselves.

Productivity improvement at the organizational, project or individual level is important and obviously should be pursued but changes also may be required in many institutional approaches. These could include: long-range consistent national planning; more extensive cooperation between government, industry, professional societies, and universities; industry working together on generic problems; and managers of technology giving more thought to why work is being done.

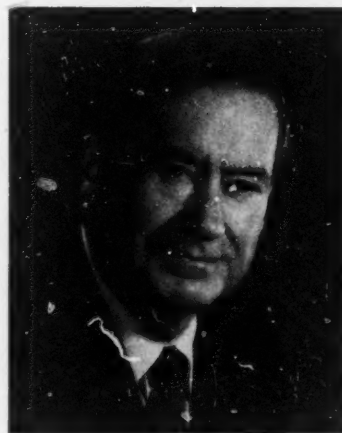
'American Manufacturers Need Proper Type of Government Support'

Jack D. Sparks
Chairman and CEO
Whirlpool Corp.

The economic challenge facing America focuses on three components: sustaining and encouraging growth in U.S. productivity; promoting the quality of U.S.-made products; and increasing the share of U.S. goods in domestic and international markets. It's our belief that these challenges can be met if business, government and employees work

together for the common good.

Two decades ago only 8 percent of the U.S. economy faced foreign competition. Today, a full 70 percent meets global competitors. This change requires flexibility, adaptation and ingenuity on the part of American industry. But it also creates new business opportunities. The international exchange of technology and the licensing of patents and processes is beneficial. It motivates us to constantly improve our



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Automated Batch Manufacturing...p. 48

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The cover: GE's Giddings & Lewis flexible manufacturing system produces components for locomotive engines

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The Push to Automated Batch Manufacturing

FMS started as spectacular installations in large plants. Now, a simultaneous push is being made to get this technology into the medium-size and smaller plants as well

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New Forging Press Increases Productivity 5:1

Modernization through in-line automation and replacement of a conventional counterblow hammer steps up crankshaft forging at a Brazilian operation

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Merry-Go-Round Assembly By Brazing Cuts Costs

A switch to lightweight brazed aluminum "tee" joints and a carousel automatic assembly machine is netting heavyweight savings for an Ohio manufacturer

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Unusual Broaching Method: Ram-Mount the Parts, Rotary-Index the Tooling

Blind splines are produced in outboard motor crankshafts at the rate of 180 an hour on an unusual dual-ram broaching machine

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Job Shops Dig In Their Heels

Round Table discusses high manufacturing costs vs. customer demands for lower-price, higher-quality parts; "domestic kanban"; and tomorrow's challenges

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Robots Credited for Bigger Forge Business

A robot duo enables a Milwaukee forging shop to more than double its capacity by virtue of 98-99 percent operating efficiency

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Wrap-Up

- Software Effects Huge Savings
- VOC Emissions Reduced
- Injection Molding Expanded
- P/M 'Knives' Costs

over the next five years and something less, perhaps 2.6%, for the last half of the period.

A Reshaped Labor Outlook

Compared with 1981, the number of work stoppages dropped by one-third in 1982 (see Table). What's more, according to Paul J. Groncki writing in Citibank's *Economic Report*, the number of days idle and the percentage of time lost were both halved. He goes on to state, "Declines of this magnitude in work stoppages are unusual even in a recession year."

Weak labor demand eroded labor's bargaining position, resulting in a slowdown in compensation growth and revisions in work rules. This allowed many companies to keep a lid on costs and prices as the economy started to pick up steam.

The result? Wage hikes averaging 3.8% in the first year of con-

tract and 3.6% annually over the life of the contract were negotiated through collective bargaining last year. The Labor Department said these were the lowest average increases since it started tracking them in 1968.

WORK STOPPAGES INVOLVING 1,000 OR MORE WORKERS

	Number of stoppages beginning in year	Days idle	
		Number* (millions)	Percent of estimated working time
1977	298	21.3	.10%
1978	219	23.8	.11
1979	235	20.4	.09
1980	187	20.8	.09
1981	145	16.9	.07
1982	90	9.0	.04

*Sum of number of days each worker was out on strike.

Source: Economic Week

In 1983, economic weakness in manufacturing will continue to affect collective bargaining results. In many industries, the recovery will not be felt until later this year

and uncertain conditions should continue to restrain wage demands.

Inflation Concerns Increase

The sharp slowing of the rate of inflation was the major tangible benefit to come out of the recession. According to Continental Bank's *Continental Comment*, the Consumers Price Index slowed to a virtual standstill in the first quarter under the combined effects of sharply falling energy prices and very small increases in the index's other components. CB points out this is typical of price behavior at the end of a recession when demand is at its weakest. It, however, feels almost certain that the rate of inflation will exceed its recent negligible growth. The bank is not looking for a return to the extremely high rates of 1979-1981. □

INDUSTRY REPORT

CAD/CAM Growth Down to Only 28 Percent

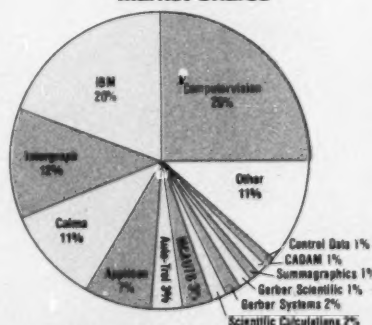
CAD/CAM industry growth slowed to 28 percent in 1982—down from 40 percent in 1981—with total revenues of just over \$1.3 billion.

According to Daratech, Inc., a Cambridge, MA, based CAD/CAM research and publishing firm, most industry executives attribute the slowdown to world-wide recession; however, few major vendors were hurt by this trend and some even wound up with record gains. The growth leaders were Intergraph, IBM, Scientific Calculations, MCAUTO and Calma, all of which reportedly gained market share at the expense of Comput-

ervision, Applicon and AutoTrol, which are said to have lost market share.

The research firm also noted that

1982 CAD/CAM Market Shares



Source: Daratech, Inc.

the CAD/CAM industry has begun to consolidate, with established turnkey vendors purchasing weaker software houses to strengthen product lines, and predicted this trend will continue through 1983.

A comprehensive directory that reviews and analyzes CAD/CAM systems and vendors is being marketed by the research firm. For further information write to: Daratech, Inc., P.O. Box 410, Cambridge, MA 02238, or circle No. 481 on the Reader Inquiry Card.

Machine Tools Headed for Upswing?

Some long-term trends may indicate an upcoming economic turn-